IRRIGATED FORESTRY PLANTATIONS IN DRY ZONES

Proceedings of a review meeting organized by the International Development Research Centre Canada

5-6 March 1985
Oxford, England

CONTENTS

PREAMBLE

Although production of food crops under irrigation has been practiced in arid and semi-arid lands for many centuries, irrigated plantation forestry on any scale is much more recent. Its practice, albeit on a modest scale, has become a feature around the world only in recent decades. The extension of irrigated plantation forestry in this way has come about in direct response to rapidly increasing demands for wood for domestic fuel, light construction and related purposes as well as fooder and fruit. Instances of the development of irrigation works primarily for wood production are rare; in nearly every case irrigated plantations have come into being as a result of opportunities to use surplus land and water in agricultural areas. Depending on the circumstances applicable in each case, irrigated plantations take many forms from single trees or rows of trees to relatively extensive block plantations.

The International Development Research Centre (IDRC) has supported, in recent years, some initial research on irrigated forestry plantations in dry zones. The yields obtained in the IDRC trials as well as in other plantations established by other organizations were often spectacular. Several questions however were raised about the economic feasibility of irrigated forestry plantations and about their real technical and physical potential. In dry zones, by definition, water is a scarce resource and irrigation is an expensive practice. Water is utilized first for human and animal consumption, then for food crops before wood production.

It became clear that further research on development program in the subject area should be guided by a review of the state of the art, particularly of technical and economic aspects. Mr. F.B. Armitage, forestry consultant, was employed to produce a synthesis based on a review of the available pertinent literature.

IDRC intended to share the result of the review with experts of institutions interested in irrigated forestry, to discuss with them the general strategies and kinds of opportunities that might best characterize further development in the area and jointly to recommend guidelines or a general plan of action.

For that purpose the draft version of the book was distributed to the participants. This was followed by a 2 day meeting to address these matters, the 5-6 of March 1985. The participants included the author of the review, technical representatives of international and country organizations supporting programs in this field and individual technical experts.

The meeting was held at Oxford, England where the Commonwealth Forestry Institute made available the necessary facilities.

OBJECTIVES

The objectives of the meeting were:

1. To analyse past experiences in dry-zone-irrigated forestry plantations;

2. To propose a set of criteria for the establishment of future plantations;

3. To identify potential sites in developing countries for irrigated forestry plantations; and,

4. To propose action to be taken in the fields of research and development, and suggest means and mechanisms for such actions.

A G E N D A

March 3-4, 1985: Out-of-town Participants arrive in OXFORD.

March 5, 1985:

I. REVIEW ANALYSIS OF PAST EXPERIENCES

a) History and Chronology.
b) Technical practices and constraints.
c) Socio-economic results and constraints.

II. APPROPRIATE SETTINGS FOR FUTURE IRRIGATED FORESTRY PROGRAMS

a) Existence of a need for trees.
b) Proven need for irrigation.
c) Availability of water.
d) Technical feasibility.
e) Socio-economic feasibility.

March 6, 1985:

III. INVENTORY OF POTENTIAL SITES FOR IRRIGATED FORESTRY PROGRAMS IN DEVELOPING COUNTRIES

(Taking into consideration the local constraints and the criteria required for appropriate settings.)

IV. REQUIRED ACTIONS AND POTENTIAL INVOLVEMENT OF NATIONAL AND INTERNATIONAL INSTITUTIONS

a) Dissemination of scientific and technical information (documents, handbooks; training).
b) Identification of Research projects:
   - fields of research (what)
   - location of research (where)
   - methodology (how)
c) Identification of development projects.
d) Potential involvement of countries and institutions.
e) Coordination and monitoring mechanisms (networks, working groups, periodic meetings, etc...).

VENUE:

The meetings took place at the Commonwealth Forestry Institute (CFI), South Parks Road, OXFORD.

Out-of-town participants were housed at "The Old Parsonage Hotel", 3 Banbury Road, OXFORD.

1. ANALYSIS OF PAST EXPERIENCE

Irrigated tree plantations comprise a fraction of one percent of the 200 million hectares of land under irrigation in the dry zones. Significant areas of them are confined to Pakistan, where plantation, mainly of Dalbergia sissoo, Morus alba and Acacia nilotica began in the 1860's, to Sudan where Eucalyptus microtheca plantations were established since 1932, and to Argentina, where more than 300,000 hectares are under poplar and willow. The plantings in the first two countries are largely in uniform stands whereas in Argentina a large proportion is integrated with agriculture. This is the latest form taken by most of the more recent developments in North and West Africa, the Middle East and India. Many of these developments are on a pilot scale.

High levels of production have characterized most of these initiatives. However, declining yields are a feature of older schemes. This is ascribed to problems such as irregular or inadequate irrigation due to poor water delivery systems, competition for water for irrigation of agricultural crops, silt accumulation and build-up of the land above water flow levels; water logging; increasing salinity; infestation by weeds; deaths of coppice stools and stand management practices that lead to inadequate occupation of the site.

Solutions lie in better planning and design; better water management, e.g. to obviate over watering with consequent waterlogging and salinity, and to ensure regular irrigation; better stand management, e.g. to reduce deaths of coppice stools and to ensure optimal site occupation, and, above all, strengthening staff technical and managerial skills.

The synthesis to be published will be a useful source book. It will bring to the attention of agriculturists and irrigationists the beneficial potential of integrating forest tree plantation with irrigated agricultural cropping. It should alert foresters to the complexity of the technology entailed and the need for inputs into irrigated forestry schemes to be made by the full range of specializations entailed. Guideline manuals specific to particular sets of conditions and irrigated forestry applications should be produced to ensure sound technical application and to stimulate technology development.

2. CRITERIA FOR FUTURE FOREST TREE PLANTATION SCHEMES

Criteria were identified to guide decisions as to whether irrigated tree plantation development, either as uniform plantations or trees integrated in some way with agricultural cropping, should be undertaken in any particular instance. They imply possible constraints on such initiatives, any one of them being capable of ruling out such development.

(a) Need for Trees or Tree Products

It is obvious that the first criteria to be considered is the existence of real needs. Sometimes actions are taken based on production opportunities without existing or foreseen demand.

Pakistan provides good examples of needs for trees and tree products that can arise in arid and semi-arid zones, viz. fuelwood, building materials (poles), saw timber including specialty woods, trees for shelter (to ameliorate human, livestock environments; to protect buildings, rivers, canals and fields through reduction of wind velocities and amelioration of local climate); trees for amenity or soil improvement, to produce forage, leaves for sericulture, oils, lak, honey, fruits, fibre, pharmaceuticals, bark, tannin. Some or all of these needs can arise suddenly, e.g. as a result of the loss of riverine forest following dam construction up-stream.

At this stage it is important that these needs are specified and quantified; that present status and future trends are measured.

(b) Need for Irrigation

It must be certain that the required tree products cannot be produced on a practical basis without irrigation. The need for irrigation might be brief, i.e. either seasonal or for the duration of the tree establishment time phase. Irrigation is usually required when, under rain fed conditions, trees either cannot be grown or would do so at low increment rates, e.g. the $0.5m^3$/ha/year or less that are common in dry lands.

(c) Availability of Land and Water

Where both land and water are available for irrigation, forestry usually has to compete for both with agriculture. Pakistan provides examples of this occuring even when government decides or decrees that a proportion of irrigated scheme areas should be set aside for forestry. Such allocations can be frustrated through increase in the needs for agricultural crops, and through harvesting methods, they are dependent on rainfall and are therefore unreliable.

(d) Technical Feasibility

Irrigation introduces an additional dimension of complexity into plantation forestry. This necessitates specialized inputs that foresters do not have, good organization and effective management. Forestry extension service is required where tree plantation is integrated with agriculutre. The sustained close attention needed for efficient project operation and maintenance and for the detection and correction of insidious problems such as waterlogging and increasing salinity, calls for a high level of motivation of properly trained staff. Labour supply must be assured and training provided as appropriate.

Rigid design approaches should be avoided since modification to layouts and operation inevitably result from changing crop patterns water demand and supply and the like. If possible, the forestry component of an integrated scheme should be built in at the initial design stage.

(e) Socio-Economic Feasibility

Returns from irrigated forestry plantations can be marginal because of low prices, high water supply, irrigation installation and plantation establishment costs and the relatively long rotations entailed. There are risks of water supply disruption and declining site fertility. Schemes producing low priced commodities such as fuelwood alone are therefore unlikely to pay. The inclusion of higher priced materials such as poles and timber and the use of multipurpose species usually helps. However, there are often strong economic grounds for integrating tree plantation with agriculture, thus reducing costs through the multiple use of water, sharing the infrastructure developed for agriculture. In these ways overall returns are increased at low cost and stability enhanced. Whatever the strategy used, economic analysis should take account of all benefits and costs, including unquantified ones.

Sociological analysis should be undertaken to ensure that people's perceptions regarding trees and the need for tree products are properly understood, that they really can benefit from irrigated forestry and that factors such as those of land tenure and the traditional practices of nomads are not overlooked.

(f) Environmental Implications

Water-borne diseases such as malaria and bilharzia plague most irrigation schemes. The introduction of trees is usually regarded with disfavour when it encourages birds that damage crops. Irrigation developments can disrupt the movements of wildlife.

3. POTENTIAL IRRIGATION SITES IN DEVELOPING COUNTRIES

Possibilities for irrigated forest plantation developments were identified in a general way across the developing world. In Pakistan large areas of apparently suitable land await development. Government policy states that 10% of irrigated agricultural areas should be allocated to forestry. This policy is rarely applied however because of the competing demands of food production for the available resources, particularly water and land. Possibilities also exist in India where new developments could be expected usually to take the form of small scale initiatives using tail or seepage water at the individual farmer level within large scale irrigation schemes.

In Sudan there are possibilities for the use of industrial waste and tail water for the expansion of plantations in irrigated sugar plantation areas, for the development of shelterbelts to protect canals and agricultural lands in areas irrigated from the Blue Nile and its tributaries and along the Nile in Northern Sudan. Canalside planting has been mooted for the Jonglei Canal, construction of which has begun. There is scope for further pilot scale development of tree plantation integrated with agriculture in irrigation schemes in several West African countries especially those along the Senegal and Niger rivers. In East Africa trials have recently been started in N.Kenya. It is believed that there will be possibilities for further initiatives in Iraq and Iran to be taken when conditions are more conducive to them.

Some potential is believed to exist for irrigated agroforestry developments in Peru, Chile and along the San Francisco River in N.E. Brazil. However the situation with regard to water availability was not known with certainty by the meeting.

4. RESEARCH NEEDS

The major fields in which research is required to develop and improve technology were seen to be

- water requirements and responses of tree species
- use of marginal quality water
- effluent re-use, including water quality and health hazards
- water application methods
- growing plantations on and managing waterlogged and saline soils
- breeding for salt and drought tolerant and fast growing tree varieties
- tree - agricultural crop designs and interactions
- fertilizer application and response
- as in research in support of rainfed forestry: tree and stand management regimes; growth and yield studies in relation to appropriate assortments of total biomass production.

5. RESEARCH AND SUPPORTING INSTITUTIONS

Countries and institutions identified as being potentially interested in participating or supporting research and technology development are:

(a) at the international level

- FAO, in both forestry and water aspects.
  This agency works with many others
- International Commission on Irrigation and Drainage (ICID) in New Delhi which has regional and national committees and comprises some experienced people
- International Irrigation Management Institute, Kandi, Sri Lanka and a sister institution currently being founded in Pakistan with Ford Foundation funding
- IBRD, which is increasingly willing to support research
- ICRISAT, Hyderabad, India
- the Arab Centre for Semi-Arid and Arid Development ACSAD), Damascus, Syria
- International Centre for Research in Dry Areas (ICARDA), Latakia, Syria
- Asian Development Bank, which has shown interest in the rehabilitation of irrigated plantations in Pakistan
- African Development Bank, which shows interest in irrigation in Africa
- International Rice Research Institute (IRRI), Laguna, Philippines, might worth contacting
- International Union of Forest Research Organization (IUFRO),

particularly Section 1.05.02: Arid Zone Plantations, and 1.07.09: Wood Plantations in the neo-Tropics

- CATIE in Costa Rica, even though it relates more to humid regions.

Nothing is known of the extent of possible interest of the Inter-American Bank or ICRAF, Nairobi, who should be contacted.

(b) at the national level

1. The proposed Indian Council of Forest Research and Education (ICFRE) with its links to
   - State forest research organizations
   - Agricultural Universities
   - Central Arid Zone Research Institute (CAZRI) at Jodhpur
   - Indian Council for Agricultural Research (ICAR), which is responsible for agroforestry research
2. Pakistan Forest Institute (PFI), Peshawar
3. The Agricultural Research Council at Wad Medani, Sudan, which is the parent body of the Sudan Forest Research Institute
4. University of Alexandria, Department of Forestry Egypt
5. INIF, INIP and INIA in Mexico: three research institutions under the Ministry of Agriculture
6. Institute of Agricultural Research (IAR), Awash, Ethiopia

7. IDRC which is already supporting irrigated forestry research development in West Africa
8. ODA which supports research in natural resources in some countries
9. Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD), France of which Centre Technique Forestier Tropical, (CTFT) is a component
10. Research institutions in Developed countries such as Australia and United States might be used as information sources or backstopping agencies.

6. COORDINATION MECHANISMS AND DISSEMINATION OF INFORMATION

Mechanisms are required for the dissemination of information, to coordinate research actions and to stimulate the production of technical guidelines. A staged, stepwise approach, supported by aid agencies as necessary, should be used, based on core institutions already active in the field.

Regional information centres should be developed. PFI in Pakistan, with its current involvement in research and training, would be a suitable start point. Others might be developed later for Latin America, Africa, the Middle and Far East.

In respect of research, networking might be developed to assist interested workers and organizations to keep abreast of developments in other areas. Note was taken of recent initiatives in this area by IUFRO with the support of IBRD and FAO.

The production of local or regional technical guidelines would likewise begin at institutions already involved in irrigated forestry, e.g. PFI, Peshawar. Such work, which FAO is well placed to support would entail small teams of specialists (foresters, irrigationists, agronomists) working together. The question of training would best be held over for attention at a future stage.

IDRC intends to support these initiatives and will proceed accordingly. The review produced by F.B. Armitage for IDRC was highly appreciated by the participants of the meeting and was considered as an important and unique in

its kind source of information on the subject. Pending publication of the source book later in the year, a letter would be sent to potentially interested agencies, institutions and individuals, together with a copy of this meeting record and a short resumé of the book, asking them to respond if interested. Announcements, including the resumé, would be sent also to journals such as World Water, Commonwealth Forestry Review, FAO Land and Water Division's Newsletter, Unasylva, Bois et Forêts Tropiques, Tree Crops Journal, Pakistan Journal of Forestry, Indian Forester, Australian Journal of Forestry. Announcements would be sent to the convenor of the forthcoming IUFRO sponsored, IBRD/DAO supported, meeting in Nairobi on forestry research, and to this year's World Forestry congress and Commonwealth Forestry Conference. Meantime the literature referenced in the bibliography of the synthesis would be lodged in the library operated by IDRC's Information Division in Ottawa.

At a later date, say in two years' time, if interest and developments warrant it, a seminar might be convened to formalize interest and decide on future actions.

APPENDIX A

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